Evaluation Procedure

Delta Delphi Series 48Vin S48SP

The Delphi Series S48SP 1”x1” Brick, 48V input, single output, isolated DC/DC converters are latest offering from a world leader in power systems technology and manufacturing — Delta Electronics, Inc. This product family is available in a surface mount or through-hole package and provides up to 36 watts of power or 10A of output current (3.3V and below) in a new 1”x1” form factor (1.3”x0.96”x0.33”). The pinout is compatible with the industry standard 1”x2” products. With creative design technology and optimization of component placement, these converters possess outstanding electrical and thermal performance, as well as extremely high reliability under highly stressful operating conditions. Typical efficiency of the 3.3V/10A module is greater than 90%. All modules are fully protected from abnormal input/output voltage, current, and temperature conditions.

This document guides the user through the evaluation procedures to qualify a S48SP module. The data shown in this Evaluation Procedure is for the 3.3V unit. Please refer to the appropriate technical data sheet for detailed performance and technical information for Delphi units with different output voltages.

Delphi Series S48SP

1.0 Purpose

This document guides the user to perform electronic measurements on a Delphi S48SP DC/DC Converter using the Delta Evaluation Board.

2.0 Relevant Documentation

The document and general knowledge listed below is relevant to this evaluation procedure:

2.1 S48SP Series applicable Data Sheet
2.2 1”x1” Brick Power Module Evaluation Board Schematic
2.3 1”x1” Brick Power Module Evaluation Board Layout
2.4 General Test and Safety Procedures
2.5 ESD Protection

3.0 Equipment Required

3.1 (1) 0 ~ 80 V @ 0 ~10 A Power Supply (Chroma 6230K-80 or Equivalent)

3.2 (1) 4 Channel 150 MHz Oscilloscope, (1) 1× scope probe, (1) 10× scope probe. (Yokogawa DL 1540C or Equivalent)

3.3 (1) 4 1/2 Digital Multimeter (DVM3) (HP34401A or Equivalent)

3.4 (2) 3 1/2 Digital Multimeter (DVM1 and DVM2) (FLUKE 45 or Equivalent)

3.5 (1) Above 60W Electronic Load or Resistive Load (Chroma 63103)

4.0 Equipment Set-Up and Description

4.1 Connect one wire from the "+" lead of the Power Supply (Item 3.1) to the "10A" of the DVM1 (Item 3.4). Then connect one wire from the "Common" lead of the DVM1 to the "VIN +" pin of the Evaluation Board.

4.2 Connect one wire from the "-" lead of the Power Supply to the "VIN –" pin of the Evaluation Board.
Note: Use 10 AWG wire or equivalent for all connections in sections 4.1 and 4.2. Use twisted pair to reduce noise coupling.

4.3 Connect the plus "+" and minus "-" connection wires from the multimeter (item 3.3) to the "SVin +" and "SVin -" Pins on the Evaluation Board. The multimeter is designated DVM2.

4.4 Connect the plus "+" and minus "-" connection wires from the multimeter (item 3.3) to the "SENCE +" and "SENCE -" Pins on the Evaluation Board. The multimeter is designated DVM3.

4.5 Connect a BNC cable (length less than 20 inches) from BNC1 of the Evaluation Board to Channel 1 of the oscilloscope (See item 3.2).

4.6 Connect a BNC cable (length less than 20 inches) from BNC2 of the Evaluation board to Channel 2 of the oscilloscope (See item 3.2).

4.7 Connect the Positive and Negative power leads of the Electronic load (assuring correct polarity), or a resistive load to the Evaluation Board output terminal pins ("VOUT+" pin for the positive power lead and "VOUT-" pin for the negative power lead).

5.0 Thermal Management of the Converter

It is imperative that sufficient airflow needs to be provided to the converter at all times during all portions of testing. Please refer to the applicable data sheet for the proper cooling and derating necessary conditions to achieve accurate results when testing the converter.

6.0 Tests Performed

The following tests are performed at room temperature +25 °C.

6.1 Input Characteristics

- Input Voltage Range
- Input Under Voltage Lockout (Input UVP)
- No Load Input Current
- Disable (Off Converter) Input Current

6.2 Output Characteristics

- Line Regulation
- Load Regulation
- Output Ripple

6.3 Dynamic Characteristics

- Maximum Output Voltage Deviation (due to step change in load)
- Response time (due to step change in load)
- Soft Start Turn-On Time

6.4 Thermal Characteristics

- Efficiency

7.0 Test Set-Up

7.1 Initial Set-Up

1) Examine the part number of the power module to determine that the correct module is being evaluated. Note: S48SP3R310**N**R B would denote negative logic, S48SP3R310**P**R B would denote positive logic; While S48SP3R310**E**R B would denote no remote on/off pin.

2) If the power module has positive logic, switching SW1 to position HI will enable the power converter. Switching SW1 to position Low will disable the power converter.

3) If the power module has negative logic, switching SW1 to position Low will enable the power converter. Switching SW1 to position HI will disable the power converter.

4) If the power module has no remote on/off pin, the power converter will enable once the input voltage applied on.

5) Multimeters (1) Ampere / Auto range
   Multimeters (2 and 3) Voltage / Auto range

6) Scope
   Time base 1 mS
   Trigger Auto
   Channel (1)
   Volts / Div 10V
   Coupling DC
   Channel (2)
   Volts / Div 1V
   Coupling DC

7) Electronic Load
   Turn on the Electronic Load and adjust the current level. Ensure the output load does not exceed the recommended maximum current of the power module.

8) SW2 is used for trimming the output voltage. S48SP series has optional trim pin. Note: S48SP3R310NR **A** would denote no trim pin; S48SP3R310NR **B** would denote with trim pin, and such trim pin features a negative trimming method;

9) Turn SW2 to the OFF position if trim function is not being used. Turn SW2 to the Up position if trimming up is required; Turn SW2 to the Down position if trimming down is required.

7.2 Initial Power Up

1) Turn the Power Supply On and increase the input voltage (use DVM2 to monitor the voltage) until it reaches 48 volts (or the desired value).
2) Set the enable switch SW1 to the appropriate logic enable position to power module On.
3) The converter is now operating, which can be verified by observing the DVM3 (appropriate value for the nominal output voltage) and Channel 2 of the oscilloscope (appropriate value for the nominal output voltage. For example: +3.3V output for S48SP3R310NR B).
4) The converter may also be turned on by switching SW1 to the appropriate logic enable position and ramping with the voltage manually or turning on the Power Supply with a preset output voltage.
5) Toggle SW1 to the “OFF” position or shunt down the power supply after performing each test.

8.0 Test and Evaluation

8.1 Input Characteristics

8.1.1 Input Voltage Range

The Delphi S48SP DC/DC converter will operate at full load from 36Vin to 75Vin, steady state. The converter features both input under-voltage and over-voltage protection, which will not allow the converter to start up unless the input voltage exceeds the turn-on voltage threshold, but will be less than the input over voltage turn-off voltage threshold.

Test

1) Turn on the fan.
2) Set the enable switch SW1 to the appropriate enable position (defined in Section 7.1).
3) Set the input voltage to the desired operating point while monitoring DVM2.
4) Test the function of input under voltage while observing DVM2, DVM3 and Channel 1, Channel 2 of the oscilloscope. Increase the input voltage until the output of the converter reaches stability (ex: 3.3 volts of S48SP3R310NR B.) This will occur between 33 and 35 volts (please refer to the datasheet for the detailed specification).

8.1.2 No Load Input Current

Test

1) Turn on the fan.
2) Set the enable switch SW1 to the appropriate logic enable position.
3) Set the input voltage to the desired operating point while monitoring DVM2.
4) Remove the electronic or the resistive load (output load) to make module output open.
5) Note the input current from DVM1.
6) The following is the result of the No load Input Current of the DC/DC converter. The No Load Input Current is less than 50mA (please refer to the datasheet for the detailed specification).

8.1.3 Input Current Module Off (no evaluation for S48SP3R310**E**R B)

Test

1) Set the enable switch SW1 to the appropriate position to disable the power supply (as defined in Section 7.1).
2) Adjust the input power supply to the desired operating point while monitoring DVM2.
3) To read the input current from DVM1.
4) This reading is the result of the Disable Input Current of the DC/DC converter. The Disable Input current will be around 10mA (please refer to the datasheet for the detailed specification).

8.2 Output Characteristics

8.2.1 Line Regulation

Line Regulation is defined as the percentage change in output voltage caused by varying the input voltage over the specified range (36 to 75 volts) while the output load and temperature remain constant.

Test

1) Turn on the fan.
2) Set the enable switch SW1 to the appropriate logic enable position.
3) Set the output power to the desired operating point.
4) Adjust the input voltage across the converter's input range (36 to 75 volts) while

monitoring DVM3.

5) Note the maximum +/- deviation of the output voltage over the full range of the input operating voltage.

8.2.2 Load Regulation

Load Regulation is defined as the percentage change in output voltage caused by varying the output load current over the specified range (no load to full load) while the input voltage and temperature remain constant.

Test

1) Turn on the fan.
2) Set the enable switch SW1 to the appropriate logic enable position.
3) Set the input voltage to the desired operating point.
4) Adjust the output load across the converter's operating load range (no load to full load) while monitoring DVM3.
5) Note the maximum +/- deviation of the output voltage over the full range of the operating load range.

8.2.3 Output Ripple

Output Ripple is defined as the periodic AC component at the DC/DC converters output voltage. The output ripple is measured in Peak to Peak and RMS values, both done with a specific bandwidth.

Test

1) Turn on the fan.
2) Set the enable switch SW1 to the appropriate logic enable position.
3) Set the input voltage and output load to the desired operating point.
4) Adjust Channel 2 on the oscilloscope to be AC coupled @ 2uS/ Div and 50 mV/Div (or 20mV/Div depended on the output ripple) to use the 20 MHz bandwidth of the scope.

Note: The output ripple of the DC/DC converter is measured at full load operating power.

8.3 Dynamic Characteristics

8.3.1 Output Voltage Deviation

Output Voltage Deviation is defined as the response of the converter to a sudden step change in the output load current. The output voltage deviation is characterized by two important parameters: Maximum Output Voltage Deviation and Response Time, which is the length of time that the output voltage takes to return to 1% of its specified value (please refer to the datasheet for the detailed specification).

Test

1) Turn on the fan.
2) Set the enable switch SW1 to the appropriate logic enable position.
3) Adjust the input voltage to the desired operating point.
4) Set Channel 2 on the oscilloscope to be AC coupled and to 100mV/Div and 50uS/Div. Set the trigger to normal and adjust the trigger point for a positive or negative going pulse.
5) Set the Electronic Load in dynamic mode and set it for the desired load transient.
6) Measure the positive Peak or negative Peak deviation and response time of the output voltage during the load transient.

8.3.2 Soft Start Turn-On Time

Soft Start Turn-On Time is defined as the time it takes for the output rises to within 90% of its final value from the time the converter is enabled. The rise time is deliberately made slower to reduce the inrush current and to eliminate any overshoot in the output voltage.

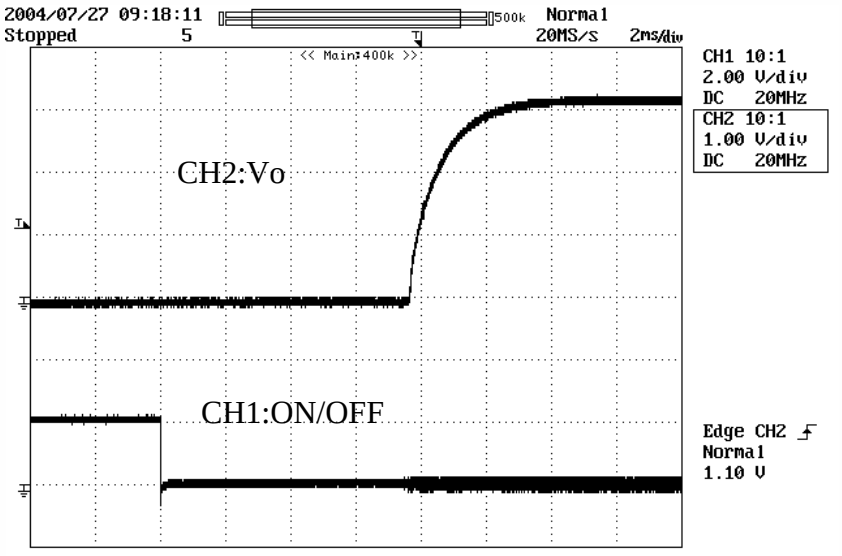
Test

1) Turn on the fan.
2) Set the enable switch SW1 to the appropriate logic disable position.
3) Turn on input Power Supply and set it to the desired operating point.
4) Connect the 10X probe (Channel 1) to the “ON/OFF” pin on the evaluation board and connect the ground clip to the “SVin –” or “VIN-” pin on the evaluation board.
5) Set Channel 1 on the oscilloscope to be DC coupled and to 2V/Div.
6) Set the Trigger for a one time event and set the Trigger level to negative going step approximately 2V on Channel 1.
7) Set Channel 2 on the oscilloscope to be DC coupled and to 1V/Div.
8) Set the Time base to 2 mS/Div.
9) Place the SW1 to the appropriate logic position to enable power and then record the waveforms on the oscilloscope.

Note: Different electronic loads may have dramatically different results because of their input characteristics during Turn-On. If the Turn-On appears abnormal, replace with an actual resistive load of appropriate value.

The Soft Start Turn-On Time of the converter provided in the Evaluation Kit was measured with the Electronic Load set at 10A.

The following scope plot shows the noted results:



Vin: 48V/10A, Outen on/off Timing: 12mS

8.4 Thermal Characteristics

8.4.1 Efficiency

Efficiency is the ratio of the total output power to the input power. It is typically measured at full load and nominal input voltage.

Test

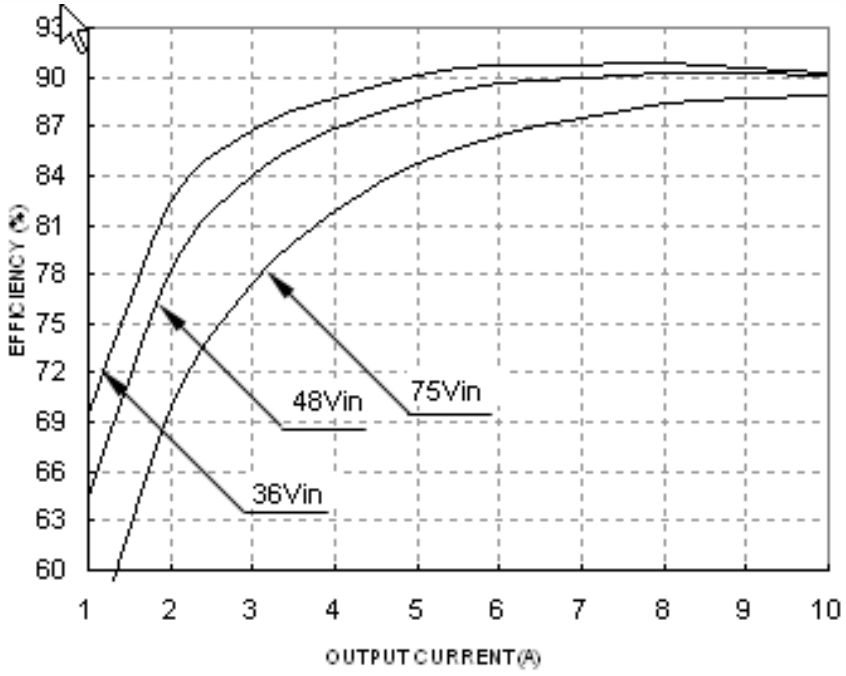
1) Turn on the fan.
2) Set the enable switch SW1 to the appropriate logic enable position.
3) Set the input voltage to the desired operation point.
4) Set the Electronic Load to a particular operating point.

5) Read and note the +3.3V output voltage (DVM3) and input voltage (DVM2).
6) Read and note the input and output currents from the DVM1 and the Electronic Load.

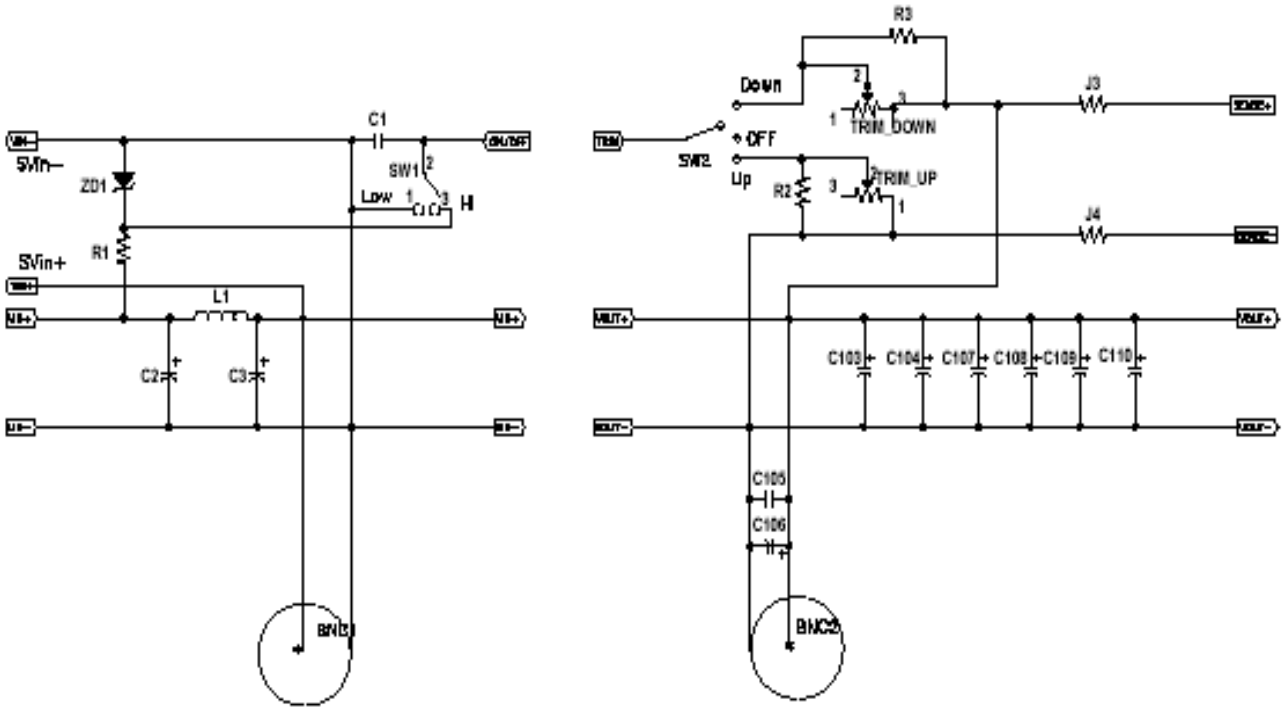
7) Use the following formulas to calculate the efficiency:

Efficiency= (Pout/Pin) × 100(%)
Pin = Iin × Vin
Pout = Iout × Vout

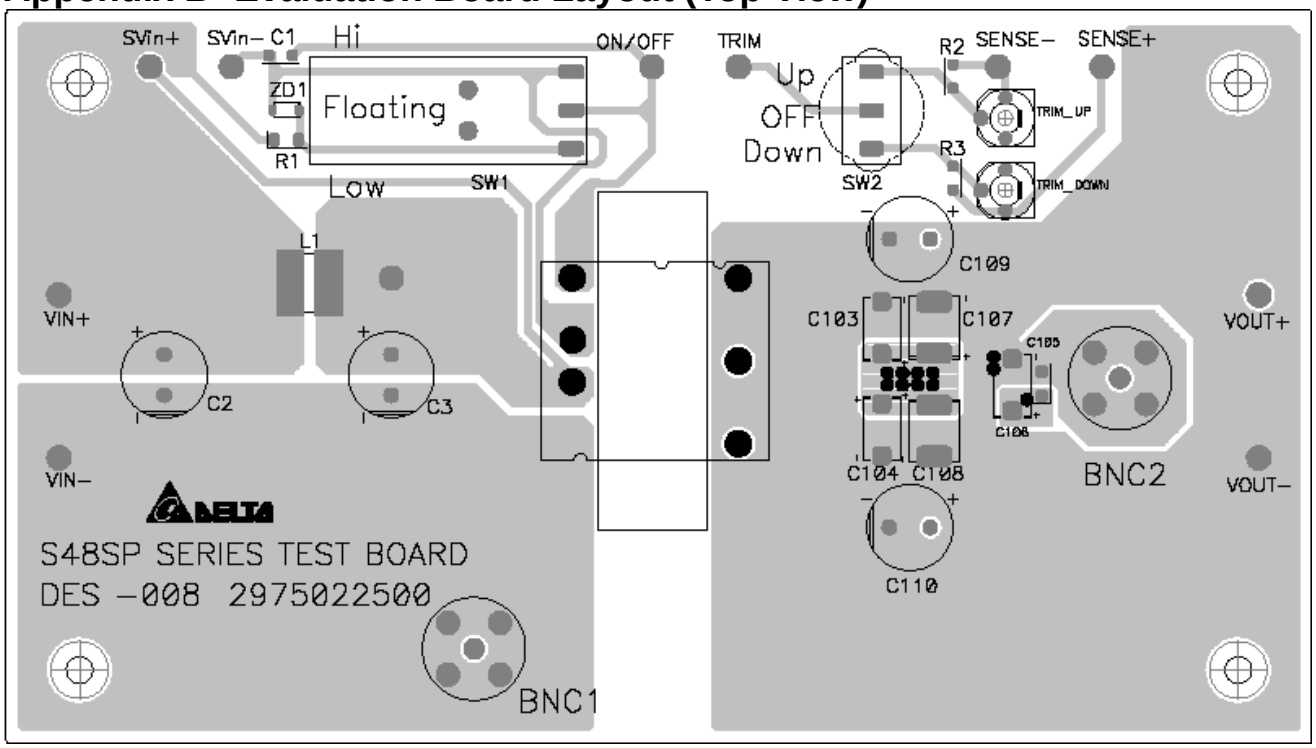
The following graph shows the efficiency test results of the S48SP3R310NR B, which is one of the S48SP Series 1”x1” Brick measured at different operating points.



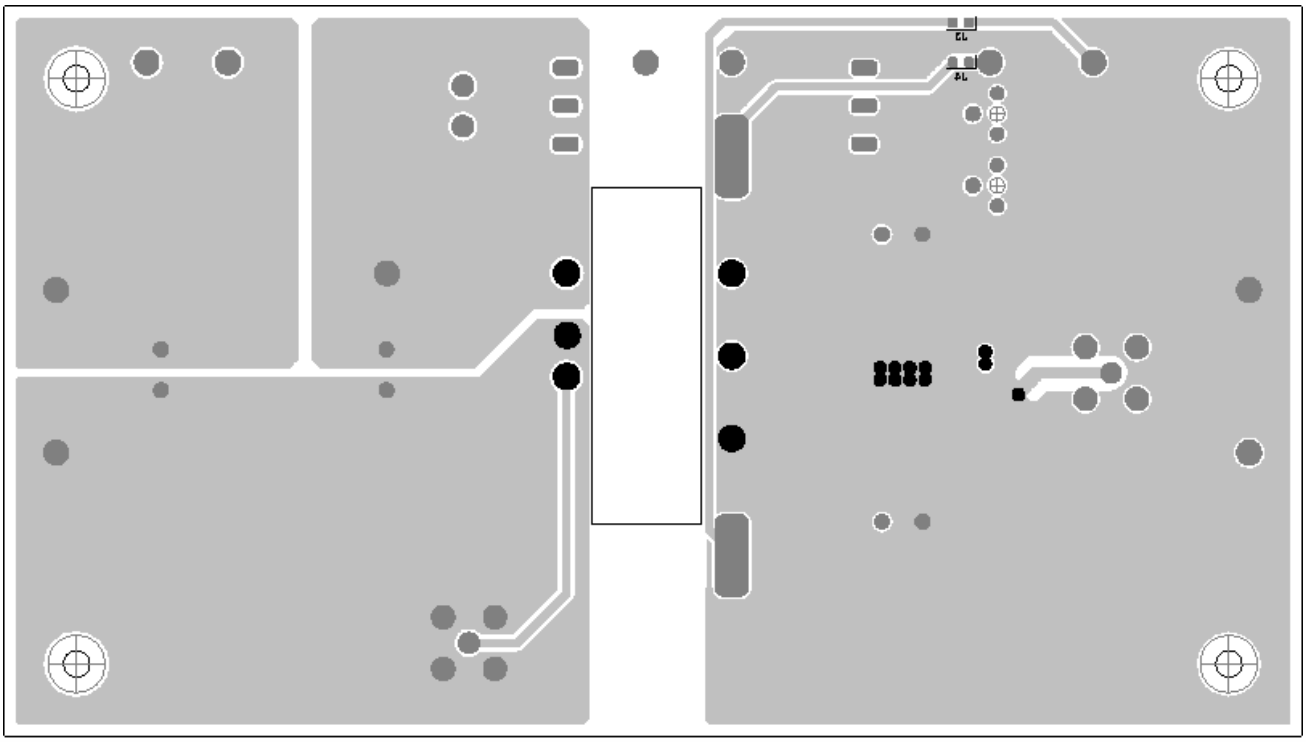
Appendix A- Evaluation Board Schematic



Appendix B- Evaluation Board Layout (Top View)



Appendix C- Evaluation Board Layout (Bottom View)



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